PATENT SPECIFICATION

DRAWINGS ATTACHED

984,250

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COMPLETE SPECIFICATION

Method of Moulding Plastics Articles and articles made by such method

We, AVISUN CORPORATION, of 1345 Chestnut Street, Philadelphia, Pennsylvania, United States of America, a corporation organized and existing under the laws of the State of Delaware, one of the United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a method of moulding plastics articles and articles made by such method. More particularly the invention relates to the manufacture of injection-moulded plastics articles bearing decorative and/or descriptive printed matter.

In general, conventional procedures, as for example decalcomania, laminating and direct printing, have not proved satisfactory for providing moulded thermoplastic articles with desired decorative or descriptive matter. Decorative or other matter applied by decalcomania and direct printing techniques is generally exposed and thus is easily damaged or abraded, while with laminating procedures the usual problems of air entrapment between layers, article distortion, and separation of layers are often encountered. The deficiencies of these known procedure are, of course, more pronounced when complicated moulded articles are being produced, and especially articles which are moulded of thermoplastic materials which have an inherent resistance to dyes or inks and lack the capacity to adhere to other materials, as for example in the case of polyalkylenes, such as polyethylene and polypropylene. Accordingly, a primary object of this invention is to provide a new and more satisfactory method for providing moulded plastics articles with decorative and/or descriptive printed matter.

According to one aspect of the invention, there is provided a method of moulding plastics articles, comprising positioning a film having printing on at least one side thereof against one wall of a mould cavity, said film having a thickness of from 3 to 11 mils, injecting a molten thermoplastic polymeric material into the mould cavity under pressure to fill the same, the film being formed of thermoplastic polymeric material having chemical and thermal properties similar, to that of the molten material injected into the mould cavity, whereby the exposed surfaces of the film are slightly fused and blend with the injected material, and thereafter cooling the thermoplastic polymeric material within the mould cavity.

The term "cooling" is used herein to include an arrangement in which the thermoplastic material is permitted to cool.

It is another object of the invention to provide a moulded article when made by the method of the invention and, according to a further aspect of the invention, such article comprises a body of fused thermoplastic material and a printing ink indicia embedded within and completely enveloped by the fused material of said body.

Generally, in accordance with the method of the present invention a thermoplastic polymeric film having decorative and/or descriptive subject matter printed thereon is positioned within a desirably shaped mould and supported against one wall thereof, after which molten thermoplastic material is injected into and solidified within the mould. During the moulding operation, the surfaces of the printed film or overlay which are exposed to the molten plastics material are fused and, in effect, lose their identity by blending with the injected plastics material. In the finished molded article, the film overlay is integrally bonded to the shaped plastics body, with generally no juncture being visible between the film and the surrounding portions of plastics material.

The thermoplastic polymeric material used

in forming the film overlay is preferably the same as that which is to be injected into the mould thereby to assure proper bonding and to avoid the introduction of differential stresses during the moulding operation and subsequent use of the finished article. The film employed may be formed by known procedures, as for example, by chill roll casting techniques, and may be printed by conventional methods using available heat resistant inks. When employing a polyalkylene film, the surface to be printed is modified, as for example by chemical treatments, oxidation, subatomic bombardment, flame treatment, and the like to render the same more receptive to the inks employed. Except for the slight orientation of the polymer molecules which may be effected during film production, the film employed in the present method is desirably in an unoriented condition.

The thickness of the film employed as the overlay is of critical importance and for satisfactory practice of the present invention ranges from 3 to 11 mils, and more desirably from about 4 to 6 mils. Films which are too thin, that is, less than 3 mils in thickness, undergo excessive and often complete fusion in the presence of the molten plastics material injected during the moulding operation. Under this condition, the printed subject matter is distorted or "runs", and is thus unattractive and/or illegible. At the other extreme, when employing film overlays having a thickness greater than 11 mils, heat from the injected plastics material is not distributed uniformly and rapidly throughout the film. As a result, the printed matter is often smeared and differential stresses are created during the molding operation, as evidenced by poor adhesion of the overlay and/or distortions in the finished article.

Support of the film overlay within the mould may be achieved by any suitable and known means. To avoid complicated moulding techniques, the film overlay is preferably supported against one wall of the mould by a static charge, with its printed surface being exposed. With films made from polyethylene or polypropylene, for example, a static charge may be induced along the unprinted film surface simply by rubbing the same with a woollen cloth.

In order that the invention may be more readily understood, one embodiment of the method thereof and an article made thereby will now be described by way of example and with reference to the accompanying drawing in which:—

FIGURE 1 is a plan view of a printed film overlay employed in carrying out one embodiment of the method of the present invention;

FIGURE 2 is a vertical cross section taken transversely through a conventional mould with the film overlay positioned therein.

FIGURE 3 is a view of the mould shown in Figure 2 after plastic material has been injected therein; and

FIGURE 4 is a perspective view of a moulded article formed by the method of the present invention.

With reference to the accompanying drawing, Figure 1 illustrates an unoriented and transparent polypropylene film 11, having a decorative design 13 printed on one surface thereof. The film 11 has a thickness within the range of from 3 to 11 mils and, as heretofore mentioned, would be pretreated to render at least one of its surfaces receptive to conventional heat resistant inks applied, for example, by known silk screening procedures.

The printed film 11 is positioned within a conventional mould 15 formed of mould blocks 17 and 19 which are shaped to provide a sprue opening 21 and a cavity 23 corresponding to the configuration desired in the finished article, as for example a serving tray. The film 11 is held snugly against the shaped surface of the mould block 17 by inducing an electric static charge in either the film or mould block, preferably with the printed surface of the film being exposed, as shown in Figure 2. Molten polypropylene is then injected under pressure through the sprue opening 21 and into the mould cavity 23. The exposed surface portions of the film 11 are fused slightly by the heat of the injected molten polypropylene and blend therewith so that the identity of the overlay as a separate film no longer exists. The heat of the injected molten polypropylene has no softening effect on the printed portions of the film, due apparently to the insulative properties of the heat resistant inks which are employed.

After a sufficient period has elapsed to insure that at least the surface portions of the injected polypropylene have solidified, the mould blocks are opened. With that portion of the injected polypropylene which had solidified in the sprue opening 21, being broken away, the finished tray 25 appears as illustrated in Figure 4, wherein the printed portion of the film overlay is encased within a body of polypropylene. As a result of the slight surface fusion effected along the exposed portions of the printed film 13 during the moulding operation, and the blending of these fused film portions with the injected polypropylene, the finished tray 25 exhibits no marks or lines which would suggest that a separate film overlay had been employed in the moulding operation.

While the method of the present invention has been described as employed in the manufacture of polypropylene articles, it will be understood that other thermoplastic polymeric materials, as for example polyethylene, may be used, providing the injected plastics material and the material forming the film

overlay have similar chemical and thermal characteristics. Further, in positioning the film overlay within the mould, its printed face may be placed against or away from the surface of the mould block on which the overlay rests. As heretofore described, the latter position is preferred since the printed matter is protected from wear in the finished article by the overlay film. If desired, opposite surfaces of the film overlay may be provided with printing. Conventional mould release agents, that is, agents which permit easier separation of the finished article from the mould, render the static attraction between the film overlay and mould block surface ineffective and should therefore generally be avoided. Additionally, to facilitate greater adhesion between the film overlay and the mould surface before the molten polymeric material is injected therein, the mould is preferably maintained in a relatively cool condition, that is, at room temperature or lower.

The following examples are provided in order more fully to illustrate the method of the present invention:

EXAMPLE I

An unoriented polypropylene film having a thickness of 4 mils was subjected to Corona discharge, after which its treated surface was provided with a decorative rose pattern by a conventional silk screening procedure and with the use of known heat resistant inks. The unprinted surface of this film overlay was then rubbed with a woollen cloth to induce a static charge therein. The film overlay was then placed within a mould having a cavity shaped in the form of a serving tray and was held snugly against one wall of the mould cavity with its printed surface exposed solely by the induced static charge.

With the mould maintained at a temperature of 27° C. molten polypropylene was injected into the mould cavity under a ram pressure of 914 kg. per square centimeter from the cylinder of a conventional plastic injecting apparatus heated to a temperature of 300° C. Injection of the molten polypropylene was completed in 15 seconds and the entire moulding cycle required a total of 45 seconds.

The serving tray moulded under the above conditions was similar to that illustrated in Figure 4 of the drawing and had a wall thickness of 0.25 cm. The printed decorative rose pattern was completely encased within polypropylene and retained its original colours and sharp detail.

EXAMPLE II

With the procedure described in Example I, a series of polypropylene films, each of 2 mils thickness, were printed with a rose pattern and were then positioned within individual moulds. Employing equipment as described in Example 1, molten polypropylene was injected into the mould cavities under ram pressures ranging from 914 to 1,125 per cm^2 from an injection cylinder heated to temperatures ranging from 260° to 300° C. The injection stages each required 15 seconds for completion during which time the moulds were maintained at temperatures ranging from 15° to 27° C.

The printed rose pattern on serving trays produced under the above conditions was blurred and in some samples appeared as a mixture of colours as a result of excessive fusion and flow of the film overlay.

EXAMPLE III

Serving trays were moulded employing the equipment, conditions and materials as set forth in Example II, with the exception that the printed film overlays had a thickness of 12 mils. The resulting moulded trays were found unacceptable due to smeared patterns and distortions in the tray walls.

WHAT WE CLAIM IS:—

1. A method of moulding plastics articles, comprising positioning a film having printing on at least one side thereof against one wall of a mould cavity, said film having a thickness of from 3 to 11 mils, injecting a molten thermoplastic polymeric material into the mould cavity under pressure to fill the same, the film being formed of thermoplastic polymeric material having chemical and thermal properties similar to that of the molten material injected into the mould cavity, whereby the exposed surfaces of the film are slightly fused and blend with the injected material, and thereafter cooling the thermoplastic polymeric material within the mould cavity.

2. A method according to claim 1, wherein the said printing has been effected with a heat resistant ink.

3. A method according to claim 1 or 2, wherein the said film has a thickness of from 4 to 6 mils.

4. A method according to claim 1, 2 or 3, wherein the film is printed on only one side and said one printed side is exposed within the mould cavity.

5. A method according to any one of the preceding claims, wherein the said film is maintained along said wall by an electric static charge.

6. A method according to claim 5, wherein the said static charge is induced within the said film.

7. A method according to any one of the preceding claims, wherein the mould cavity is at room temperature at the time the thermoplastic material is injected therein.

8. A method according to any one of the preceding claims, wherein the film is unoriented.

9. A method according to any one of the preceding claims, wherein the film and molten material are comprised of isotactic polypropylene.

10. A method according to claim 9, where-

in the film surface has been treated to render it receptive to the printing ink.

11. A moulded article when produced by the method of claim 1 and comprising a body of fused thermoplastic material and a printing ink indicia embedded within and completely enveloped by the fused material of said body.

12. A moulded article according to claim 11, wherein the indicia is disposed from at least 3 to 11 mils away from the nearest adjacent surface of said body.

13. A method of moulding plastic articles, substantially as hereinbefore described with reference to the accompanying drawings.

14. A method of moulding plastic articles, substantially as hereinbefore described with reference to Example I.

15. A moulded article when made according to the method of any one of claims 1 to 10 and 12 and 13.

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984250 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

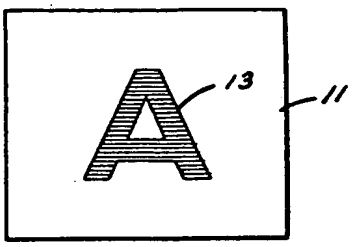

Fig. 1

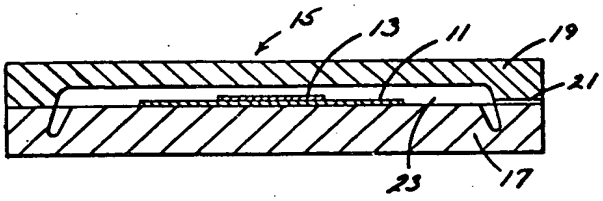

Fig. 2

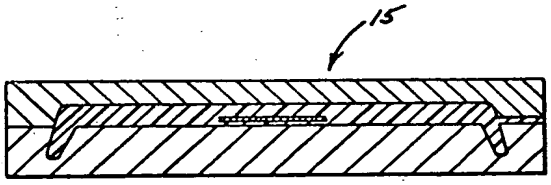

Fig. 3

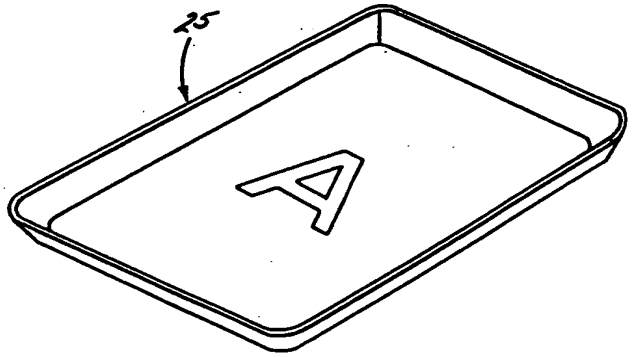

Fig. 4